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CATEGORIZATION OF BENZENE WASTES

The Proposal

The Ontario Ministry of the Environment is proposing to add certain wastes contaminated with benzene to a list of hazardous industrial wastes (Schedule 1) in Regulation 309 of the *Environmental Protection Act*. This change would subject producers and users of benzene in Ontario to additional regulations designed to ensure the safer disposal of these benzene wastes.

The categorization procedure provides for public consultation before any action is taken. The results of these consultations are reviewed by an independent Hazardous Waste Advisory Committee. The members of this Committee, who are selected from scientific, academic and public groups, make the final recommendation regarding the proposed categorization.

Properties of Benzene

Benzene (sometimes commercially called benzol) is a clear, colourless and highly flammable liquid with a characteristic odour. It is derived from petroleum, natural gas, or coal. Its molecular formula is C_6H_6, which means that a benzene molecule contains six carbon atoms and six hydrogen atoms. The atoms are clustered in a regular hexagonal ring, an arrangement that is specific to the aromatic class of hydrocarbons.

Benzene is quite volatile, which makes it a good solvent. It is also highly flammable, with a flash point of -11 degrees Celsius. Pure liquid benzene boils at 80 degrees Celsius and freezes at 5.5 degrees Celsius. It is also somewhat soluble in water, compared to other hydrocarbons.

Producers and Users of Benzene

In Ontario, benzene is produced mostly in petroleum refining operations. Four of Canada's seven producers of benzene operate in Ontario. A minor portion (about 15 percent) of the benzene produced in Ontario comes from the light oil by-product of coke production in the steel industry. Virtually all transportation of benzene in Ontario is done by pipelines or rail tank cars.

Nearly 70 percent of the benzene produced in Ontario is used as a raw material for the production of styrene. Six major chemical industries using benzene are known to operate in Ontario. Benzene is also used as a solvent in the manufacturing of styrene-butadiene rubbers. Due to its carcinogenicity, use of benzene as a solvent is decreasing, but it may still be used by manufacturers of paints, rubbers, cements, adhesives, paint removers, artificial leather and rubber goods. Benzene may also be used in shoe manufacturing, rotogravure printing and chemical laboratories.

Benzene is also found in gasoline as a residual chemical from petroleum refining. Concentrations of benzene in commercial gasoline average two percent in Ontario.

Potential Hazards of Benzene

Benzene has been shown to cause cancer in rats. Several studies have suggested a strong relationship between benzene exposure and leukemia. Acute exposure to benzene has also been shown to be fatal to fish and mammals due to direct narcotic effects. It is also lethal on contact to earthworms, and has toxic effects on plant life, inhibiting growth and photosynthesis.

In humans, long-term inhalation of high concentrations of benzene results in abnormalities in the blood and damage to the central nervous system. Benzene is considered to be a human carcinogen by the United States Environmental Protection Agency (USEPA), the World Health Organization (WHO), and the International Agency for Research on Cancer (IARC). In Ontario, benzene is also classified as a special substance by the Ministry of Labour and the Ministry of the Environment, because of carcinogenicity.

The flammability of benzene creates a fire hazard in storage, transportation and use. Its volatility makes it highly susceptible to escaping into the atmosphere, where it may be inhaled by humans or animals, exposing them to potential toxic effects, as well as increasing the risk of developing cancer.

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Benzene in the Environment

Because of its high volatility, nearly 80 percent of the benzene released into the environment goes into the air. The remaining 20 percent is released by benzene producers and users either in water effluents or in solid wastes.

The most important sources of benzene emissions into the air are gasoline handling and motor vehicle exhausts. Emission of air contaminants, including benzene, is regulated by Regulation 308 of the *Environmental Protection Act*, and administered by the Air Resources Branch.

The primary waste management concern is the potential appearance of benzene in groundwater as a result of leaching from landfills. It is estimated that 39 tonnes of benzene per year are released in solid wastes by Ontario producers, and a further 44 tonnes per year are released by users in the chemical industry. A much smaller amount, estimated at less than one tonne per year, is released by general users of benzene as a solvent.

Present Regulations

Benzene is already regulated under various Ontario and Canadian laws. It is presently listed in Schedule 2B of Regulation 309 of the *Environmental Protection Act* as a "hazardous waste chemical". (The proposed listing in Schedule 1 would subject benzene wastes to additional controls.)

The Air Resources Branch of the Ontario Ministry of the Environment is presently reviewing the standards for benzene in Regulation 308 which might limit air emission from industries by requiring use of the "best available technology" to attain the "lowest achievable emission rate".

The Ontario *Occupational Health and Safety Act* already subjects benzene to certain emission controls in working areas, and requires that workers handling benzene wear protective equipment.

The federal *Transportation of Dangerous Goods Act* lists benzene as dangerous because it is flammable (Class 3.2) and because it is hazardous to the environment (Class 9.2). Benzene is also the subject of similar legislation in the United States.

Conclusions and Recommendations

Benzene wastes generated in the production process are already listed in Schedule 1 and are managed as part of the producing refineries' hazardous wastewater streams.

Benzene wastes generated from organic chemical manufacturing take the form of spent catalysts contaminated with benzene, as well as reactor and column bottoms and residues. These streams are not currently listed under Regulation 309. Spent benzene or benzene mixtures used as solvents are also not listed under Regulation 309.

It is recommended that specific waste streams in the organic chemical industry be listed in Schedule 1. Because of the wide range of uses of benzene and benzene mixtures as solvents, it is recommended that all spent solvents or still bottoms from the recovery of these solvents containing benzene be listed under "non-specific sources" in Schedule 1.

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